



University of Kentucky  
**UKnowledge**

---

MPA/MPP Capstone Projects

Martin School of Public Policy and  
Administration

---

2017

## The Effects of Overcrowding on Student Academic Performance in Kentucky High Schools

Maura Shirley

University of Kentucky, [maura.shirley@uky.edu](mailto:maura.shirley@uky.edu)

Follow this and additional works at: [https://uknowledge.uky.edu/mpampp\\_etds](https://uknowledge.uky.edu/mpampp_etds)



Part of the [Educational Assessment, Evaluation, and Research Commons](#), [Education Policy Commons](#), and the [Secondary Education Commons](#)

**Right click to open a feedback form in a new tab to let us know how this document benefits you.**

---

### Recommended Citation

Shirley, Maura, "The Effects of Overcrowding on Student Academic Performance in Kentucky High Schools" (2017). *MPA/MPP Capstone Projects*. 283.

[https://uknowledge.uky.edu/mpampp\\_etds/283](https://uknowledge.uky.edu/mpampp_etds/283)

This Graduate Capstone Project is brought to you for free and open access by the Martin School of Public Policy and Administration at UKnowledge. It has been accepted for inclusion in MPA/MPP Capstone Projects by an authorized administrator of UKnowledge. For more information, please contact [UKnowledge@lsv.uky.edu](mailto:UKnowledge@lsv.uky.edu).

**MARTIN SCHOOL OF PUBLIC POLICY AND ADMINISTRATION**

# **The Effects of Overcrowding on Student Academic Performance in Kentucky High Schools**

**Maura Shirley**

**MPA Capstone**

**University of Kentucky**

**Spring 2017**

**Faculty Advisor:**

**Dr. Eugenia Toma**

## Table of Contents

Executive Summary.....	3
Introduction.....	4
Policy Question.....	5
Literature Review.....	6
<i>Overview of Overcrowding in Schools</i> .....	6
<i>Overcrowding Symptoms and Remedies</i> .....	7
<i>Overcrowding and Student Academic Performance</i> .....	10
Research Methods.....	11
<i>Variables and Regression Equation</i> .....	12
Results.....	16
Limitations.....	19
Conclusions and Recommendations.....	20

## Executive Summary

Overcrowding in schools has been a popular topic reported by local newspapers across the state of Kentucky. Concerned parents often write letters to the editor, pleading their case for new school construction to alleviate the overcrowding that their students are facing.

Approximately 27 percent of Kentucky high schools have experienced overcrowding for three consecutive years between 2002 and 2015. The National Center for Education Statistics reported in 2005 that only 18 percent of schools reported that they were overcrowded, a decrease from the 1999 study when 22 percent reported overcrowding. Overall, the problem of overcrowding is trending downward, but for the students who attend schools that remain overcrowded, the visibility of the issue makes it one that receives ample attention. The concern of parents, teachers and administration about the effects of overcrowding and the plea for new construction has inspired this study, which stands among just a few similar studies found in the literature of overcrowding in schools. This study attempts to unveil the assumed negative effects of overcrowding and make policy recommendations based on the findings.

This study examines 192 Kentucky High Schools between the years 2002 and 2015. Schools that reported enrollments above 105 percent of capacity were considered overcrowded. Other demographic and school wide aggregate data were used as controls for the fixed effects panel regression. The results of the study found that overcrowding, for three, four and five consecutive years, does not have a statistically significant effect on student academic performance, as approximated by ACT composite scores of eleventh graders. The study did find that student teacher ratio does have a negative effect on ACT composite scores, which provides evidence that symptoms of overcrowding should be monitored and policy should reflect this concern.

## Introduction

The Scott County, Kentucky school district is home to eight elementary schools, three middle schools, one technical school and one high school. The high school's enrollment has increased from 6% over capacity to 56% over capacity over the last ten years. This has put stress on the facility, as well as the teachers and students. In the fall of 2016, the Scott County School Board discussed formal plans for building a second high school as a remedy for overcrowding as well as the need for a nickel tax (5 percent increase to existing property tax) to raise capital funds to support the new construction. The community is largely in favor of new construction and believes it will provide much needed relief, as Scott County's population continues to grow. According to the Herald Leader, a local newspaper in neighboring Fayette County, parents have become frustrated with the lack of response to overcrowding by the Scott County School Board. "The school board has said that the overcrowding at the school-which is at least 20 percent over capacity- has not hurt the quality of education" (Meehan, 2016). However, parents in the school district claim that "Scott County does have lower college readiness scores than high schools in surrounding counties and... the quality of an education goes beyond test scores...It's past time for action" (Meehan, 2016).

Overcrowding in schools has been a topic of many education policy researchers. It has become a subject that is often reported in local newspapers and is discussed in teacher's lounges across the country. Teachers worry about meeting the needs of more students and with fewer resources. Students and parents complain about classroom conditions and insufficient books and lockers for students. Over the years, researchers have looked at why many urban schools are over capacity and proposed solutions to the overcrowding, such as private schooling and opening new facilities. Overcrowding hasn't received the same research attention as other topics in education

such as income and education levels of parents of students, early childhood education and teacher effects on student performance. Class size is related to the issue of overcrowding, and this problem has been studied in depth via the famous experimental Tennessee STAR study (Nye et al. 1999). However, the problem of overcrowding has many different causes and implications. Growing class size is just one symptom of school overcrowding. Because overcrowding can be a costly problem to address, I believe its effects warrant more investigating.

### Policy Question

This study explores the incidence of overcrowding among Kentucky high schools, and calculates the degree of overcrowding by comparing capacity to student population. Previous research designates a school as overcrowded if its student population is over 5% greater than the facility's capacity (NCES). Using this as a standard measure of overcrowding in this study, along with several other independent variables including school wide demographics, facility information, and federal funding statistics, the effects of overcrowding on student performance will be analyzed.

There are many possible policy implications for the findings of this study. School boards have tried to remedy overcrowding for years through the use of year-round school calendars, temporary portable classrooms, magnet schools and the construction of new facilities. There are policies in place in Kentucky that designate the priority of needs for school districts. This study will help determine the effects of overcrowding on student performance in Kentucky high schools and may be used to inform future policies regarding remedies through new facility construction.

## Literature Review

### *Overview of Overcrowding in Schools*

Over the past 2 decades, the topic of overcrowding in schools has piqued the interest of policy makers and researchers. Teachers and students on the front lines deal with the issue of overcrowding every day and feel its effects. Overcrowding has been defined by these researchers and policy makers in different ways over the years and in broad terms is described as a school that has enrolled more students than the facility was created to accommodate. In 1999 the National Center for Education Statistics narrowed the definition of overcrowding using the following formula:

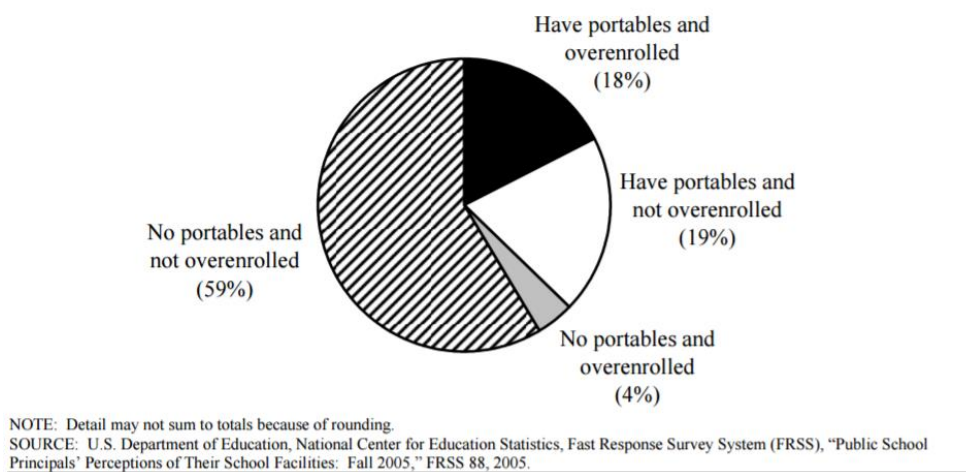
$$X = \frac{[(\text{total student enrollment}) - (\text{capacity of permanent instructional buildings and space})]}{(\text{capacity of permanent instructional buildings and space})} \text{ (NCES 2000, 45).}$$

This formula results in a percentage that is then used to determine overcrowding. “When the value of the proportion was over 5 percent and positive, the enrollment exceeded the building’s capacity, and the school was considered overcrowded (or overenrolled)” (NCES 2000, 45). By using this percentage as a marker, many schools in the United States at the time this report was published, were under enrolled and below school capacity. However, “about a quarter [of the schools were] overcrowded based on the capacity of their permanent instructional buildings and space” (NCES 2000, 46). This definition is important to the research conducted on overcrowding as well as to policy makers in school districts across the country that make capital project plans based on overcrowding in schools.

## *Overcrowding Symptoms and Remedies*

One part of the definition in particular “permanent instructional buildings and space” (NCES 2000, 46) brings into question the use of temporary structures such as mobile classrooms to alleviate symptoms of overcrowding. These have increasingly become a mainstay in schools in the United States as they are often an affordable alternative to new construction.

**Figure 1 Percentage of public schools with and without portables, by overenrollement status: Fall 2005**



According to the NCES Principals Report of 2005, about 18% of overenrolled schools have portable classrooms (Figure 1). This figure also shows that about 19% of schools that are not overcrowded are also using portable classrooms (NCES, 2005, 8). One-third of the principals of schools with portable classrooms popularly cited the following three reasons for their use: “An increase in enrollment (69 percent), initiatives to reduce class size (34 percent), and a need to add or expand an academic support program (33 percent)” (NCES, 2005, 9). However, some researchers argue that these structures are not always perfect substitutes of traditional classrooms. In scholars, Rivera-Batiz and Marti’s 1995 study of NYC schools, they conclude that “Insofar as students find it harder to concentrate and get motivated in cramped, unsuitable space, overcrowding would have a negative impact on student achievement” (Rivera-Batiz and Marti



1995, 5). Similarly, in a study of California schools by Lee, Ready and Welner, portable classrooms were cited as “detrimental for the state’s most disadvantaged students... [and] actually exacerbate inequality in educational outcomes by race, ethnicity, and class” (Lee, Ready, and Welder 2002, 33). This leads scholars and school boards alike searching for the best solutions to address overcrowding, which is exactly how many education scholars approach this topic in the literature. Overcrowding can have very visible impacts on schools that lead parents, teachers and communities to believe academic performance is adversely effected. However, this assumed correlation has not received much attention by scholars. Class size is one of the visible and discernible effects of overcrowding and has been deeply analyzed. Understanding the existing literature about this topic and others related to overcrowding will help build context for this particular study.

The Tennessee STAR experiment conducted in the 1980s has become a shining example of experimental design in the educational research field. This study looked at the effects of class size on student academic performance through a five year follow up that was published in 1999. Class size is often confused with overcrowding, but increased class size is just one, very important symptom of an overcrowded school. The Tennessee STAR experiment found that there were long-term (5 years), positive effects on students who had been in smaller classes (Nye, Hedges, and Konstantopoulos 1999). Being an experimental design, this study has been widely used to justify finding quick solutions to overcrowding, as students in overcrowded schools may be subject to classrooms with large student teacher ratios.

There have been a number of researchers who have looked into the effects of private schooling, bussing, and year-round calendars as a means of reducing class size as well as for providing more resources (books, teachers, aids, desks, lockers, etc.) to students in overcrowded

schools. A study conducted by Jennifer Graves in 2010 showed that using a multi-track year-round calendar as a means to alleviate overcrowding can actually have a negative impact on student academic performance (Graves 2010). A multi-track year-round calendar allows more students to use facilities by operating on separate schedules with periodic breaks. These alternating schedules help to maximize utilization of school facilities, save on operating costs and serve more students. However, because of the disruptive nature of the school schedule and added stress on teachers, the test scores of students suffered by a 1-2% drop in national percentile rank (Graves 2010). Short-term solutions, like multi-track year-round calendars are used by many schools across the U.S. as a cost-saving measure. The alternative, building new facilities takes years of planning and millions of dollars to complete. This solution, however is seen by some researchers as the best and only permanent remedy of overcrowding. Scholars, Lee, Ready and Welner wrote an interpretive study on California schools' responses to overcrowding through the use of portable classrooms, multi-track year round calendars, using non-classroom space for instructional use and even hiring unprepared teachers to meet student demands. In this study they conclude, "The only appropriate solution to school overcrowding is to construct new schools" (Lee, Ready, and Welner 2002, 33). This study as well as other pieces of literature, including a study conducted by Jones and Zimmer in 2000, take into account the costs associated with alleviating overcrowding. Jones and Zimmer delve into the effects of capital spending on student academic achievement in Michigan schools and find that spending on capital (school buildings, athletic facilities, etc.) positively affect student academic achievement (Jones and Zimmer 2000, 585). The literature shows that spending money on capital assets has important consequences on student academic performance. This correlation

then brings into question how strong the effects of overcrowding are on the outcome that schools prioritize: student academic performance.

### *Overcrowding and Student Academic Performance*

Finding the degree to which overcrowding has an effect on student academic performance will be the purpose of this paper. This endeavor was also undertaken by Rivera-Batiz and Marti in 1995 through a study of New York City's public schools. That study was inspired by the growth in student populations in NYC during the 1980's and 1990's. The rapid growth caused many public schools to overcrowd which posed the question of potential effects on students and teachers. This study was unique in that it took two different approaches to understand the effects of overcrowding. The researchers used both quantitative and qualitative methodologies to understand the impact of overcrowding. During their study they found that the effects of overcrowding were strong in schools with a "high proportion of students with low socioeconomic backgrounds" (Rivera-Batiz and Marti 1995, 1). In fact students scored "two to nine percentage points lower than in schools that were not overcrowded" (Rivera-Batiz and Marti, 1995, 1). The results for overcrowded schools with high proportions of students with higher socioeconomic backgrounds were starkly different. These results showed that students performed better in over-utilized schools, than in schools that were not overcrowded. These results were somewhat anticipated by the researchers as they identified issues with reverse causality in their study, an integral part of understanding the connection between overcrowding and student performance that will be discussed in the research design section of this paper. "It is possible that schools with high average academic achievement attract more students, and therefore, cause overcrowding" (Rivera-Batiz and Marti 1995, 6).

The qualitative survey results from this 1995 NYC public school study showed that overcrowding was a top concern of teachers and it is considered a “an extremely serious issue” that made students and teachers feel “overwhelmed, discouraged and often disgusted with the space shortage and its consequences for learning”(Rivera-Batiz and Marti 1995, 1). These results, though taken from a school district whose demographics are more diverse, provides a strong case for why the issue of overcrowding in Kentucky high schools should be studied. Teachers and students, albeit informally, have expressed similar concerns about overcrowding in their schools. The section that follows will detail the research design created to discern the effects of overcrowding on student academic performance on high school students in Kentucky and will use previous research to guide and inform the design and presentation of results.

### Research Methods

The literature shows that overcrowding is affecting a small portion of schools across the United States, but the costs of alleviating overcrowding can be very expensive. As population numbers rise, and immigrants travel to the country, some schools are pushed to their limits to accommodate as many students as possible. This problem poses a question about the impact of overcrowding on students, teachers and facilities. This study concentrates on what I believe should be the primary concern regarding this issue: student academic performance. What effect, if any, does overcrowding have on student academic performance in Kentucky high schools?

Student academic performance has been studied using many different empirical approaches. In order to capture as much information and effects as possible, this study will be conducted using a panel regression fixed effects model. The study will try to decipher the effects of overcrowding on school performance by controlling for the many variables that have been identified in previous research to have an effect on this particular outcome. A panel regression

fixed effects model uses multiple years of data and corresponding observations to account for varying differences across those observations. The more observations, the more generalizable the results of the panel regression. For school and student based studies, panel regressions, specifically fixed effects, are used to control for the abundance of factors that affect student performance and thus guide policy makers and school leaders to understand specific relationships between student academic performance and a policy goal in question. In this study, a fixed effects panel regression is used to help control for the unobservable characteristics of the schools in the data set. Some of these include cultural norms of the schools, school history, and student and teacher motivation. I have specified this study as a fixed effects model to further account for immeasurable characteristics of the schools in the data that are fixed, or constant between observations.

#### *Variables and Regression Equation*

In order to determine the effects of overcrowding on student academic performance in Kentucky high schools, schoolwide information has been gathered from the National Center for Education Statistics, Common Core of Data. This information includes Kentucky high school demographics such as race, percentage of students on free and reduced lunch (a measure of socioeconomic status), district enrollment growth, student-teacher ratio, and average years of teacher experience. ACT scores for eleventh graders were collected from the Kentucky Department of Education School Report Cards. The information gathered from both sources includes 192 Kentucky high schools with data collected over thirteen years (2002-2015). The demographic information will also include facility capacity numbers as reported by District Facility plans made available through the Kentucky Department of Education. In order to determine if a school is overcrowded the enrollment numbers for each year reported, as well as

the capacity, will be inserted into the overcrowding equation created by the National Center for Educational Statistics. Schools at or above 105% of capacity will be labeled as overcrowded.

This information will be used as a binary variable in the data set.

Table 1

Variable Name	Observations	Mean	Std. Deviation	Min	Max	Type of Variable	Binary or Continuous
ACT Composite Scores of Eleventh Graders	1,513	18.63	1.571	9.2	26.9	Dependent	Continuous
Three Years of Consecutive Overcrowding	713/2,606	.273	.445	0	1	Explanatory	Binary
Four Years of Consecutive Overcrowding	627/2,606	.241	.427	0	1	Explanatory	Binary
Five Years of Consecutive Overcrowding	546/2,606	.209	.407	0	1	Explanatory	Binary
District Enrollment Growth	2,421	.005	.084	.369	3.42	Explanatory	Continuous
Percentage of Students on Free & Reduced Lunch Program	2,035	420.239	207.049	0	1195	Explanatory	Continuous
Percentage of Asian Students in a School	2,407	.824	1.27	0	12.87	Explanatory	Continuous
Percentage of Hispanic Students in a School	2,407	1.811	2.40	0	21.028	Explanatory	Continuous
Percentage of Black Students in a School	2,407	8.771	12.958	0	83.158	Explanatory	Continuous
Student Teacher Ratio	2,391	17.176	2.350	7.8	37.1	Explanatory	Continuous
Average Years of Teacher Experience	2,605	11.771	1.895	5	18.6	Explanatory	Continuous

The dependent variable, or outcome variable in the panel regression equation will be ACT composite scores for eleventh graders. The ACT is “an entrance exam used by most colleges and universities to make admission decisions” (The Princeton Review, 2017). All eleventh graders in Kentucky have been administered the ACT during one school day each year since 2007. The composite score is an average of each score of the four sections: English, Reading, Math and Science. The independent variables will include the demographic information discussed previously. Separate analyses using the same panel regression fixed effects equation will be used to identify effects of sustained overcrowding (three years, four years, and five years consecutively) through the use of lag values of the overcrowding binary variable.

**Equation 1:**  $Y_{it} = \alpha_i + TY_{i,t-3} + DEG_{it} + FR_{it} + A_{it} + H_{it} + B_{it} + ST_{it} + AX_{it}, fe$

In equation 1, let  $Y_{it}$  = ACT composite scores for eleventh graders in a school (i) in year (t);  $TY_{it}$  = overcrowding of a school (i) in previous three years (t-3);  $DEG_{it}$  = district enrollment growth in a school (i) in year (t);  $FR_{it}$  = total free and reduced lunch in a school (i) in year (t);  $A_{it}$  = percentage of student population that is Asian in a school (i) in year (t);  $H_{it}$  = percentage of student population that is Hispanic in a school (i) in year (t);  $B_{it}$  = percentage of student population that is Black in school (i) in year (t). The null hypothesis for this equation is that overcrowding for three consecutive school years does not have an effect on ACT scores of eleventh graders.

**Equation 2:**  $Y_{it} = \alpha_i + FY_{i,t-4} + DEG_{it} + FR_{it} + A_{it} + H_{it} + B_{it} + ST_{it} + AX_{it}, fe$

In equation 2, let  $Y_{it}$  = ACT composite scores for eleventh graders in a school (i) in year (t);  $FY_{it}$  = overcrowding of a school (i) in previous four years (t-4);  $DEG_{it}$  = district enrollment growth in a school (i) in year (t);  $FR_{it}$  = total free and reduced lunch in a school (i) in year (t);  $A_{it}$  = percentage of student population that is Asian in a school (i) in year (t);  $H_{it}$  = percentage of

student population that is Hispanic in a school (i) in year (t);  $B_{it}$  = percentage of student population that is Black in school (i) in year (t). The null hypothesis for this equation is that overcrowding for four consecutive years does not have an effect on ACT scores of eleventh graders.

**Equation 3:**  $Y_{it} = \alpha_i + FVY_{i, t-5} + DEG_{it} + FR_{it} + A_{it} + H_{it} + B_{it} + ST_{it} + AX_{it} + \epsilon_{it}$

In equation 3, let  $Y_{it}$  = ACT composite scores for eleventh graders in a school (i) in year (t);  $FVY_{it}$  = overcrowding of a school (i) in previous five years (t-5);  $DEG_{it}$  = district enrollment growth in a school (i) in year (t);  $FR_{it}$  = total free and reduced lunch in a school (i) in year (t);  $A_{it}$  = percentage of student population that is Asian in a school (i) in year (t);  $H_{it}$  = percentage of student population that is Hispanic in a school (i) in year (t);  $B_{it}$  = percentage of student population that is Black in school (i) in year (t). The null hypothesis for this equation is that overcrowding for four consecutive years does not have an effect on ACT scores of eleventh graders.

This study and the nature of the variables do raise concerns about reverse causality. Batiz and Marti recognized this issue in their 1995 study as well. Sometimes schools become overcrowded because of their location and lack of options for students to enroll. However, sometimes schools are overcrowded because they are high performing and thus attract large numbers of students. When trying to discern the effects of overcrowding on student academic performance, this can pose a problem because a school may be overcrowded due to its high student academic performance, and data would thus show that an overcrowded school leads to higher student academic performance. This limitation could hinder the interpretation of the results, so an enrollment variable that measures the percentage change in school enrollment from year to year, is included in each equation to help control for this.



## Results

The first regression equation includes a measure of schools with three years of consecutive overcrowding as a lag variable. The results of the regression are shown in Table 2.

Table 2

The Effects of Three Years of Consecutive Overcrowding on ACT Composite Scores for Eleventh Graders

VARIABLES	act_c_11
Three Years	-0.0544
	(0.590)
District Growth	-0.217
	(0.620)
Free & Reduced Lunch	0.000130
	(0.758)
Percent Asian	0.0263
	(0.509)
Percent Hispanic	0.213***
	(0)
Percent Black	-0.0339**
	(0.045)
Student Teacher Ratio	-0.0332***
	(0.00065)
Teacher Experience	0.0340*
	(0.0804)
Constant	18.46***
	(0)
Observations	1,289
Number of Schools	192
R-squared	0.130

pval in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The results from the first table show that a school with three years of consecutive overcrowding is not statistically significant and therefore I fail to reject the null hypothesis. The data does show that student teacher ratio is significant and is negatively correlated to ACT composite scores of eleventh graders. Specifically, as student teacher ratio increases (more

students to teachers), ACT composite scores of eleventh graders decreases by .0332. These results are interesting as a higher student teacher ratio could be a result of overcrowding, though overcrowding is not significant in this model.

Table 3

The Effects of Four Years of Consecutive Overcrowding on ACT Composite Scores for Eleventh Graders

VARIABLES	act_c_11
Four Years	-0.0664
	(0.528)
District Growth	-0.214
	(0.625)
Free & Reduced Lunch	0.000144
	(0.733)
Percent Asian	0.0269
	(0.498)
Percent Hispanic	0.212***
	(0)
Percent Black	-0.0339**
	(0.045)
Student Teacher Ratio	-0.0331***
	(0.0006)
Teacher Experience	0.0340*
	(0.0805)
Constant	18.46***
	(0)
Observations	1,289
Number of Schools	192
R-squared	0.130

pval in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 3 shows the second regression equation which includes a measure of schools with four years of consecutive overcrowding as a lag variable. These results were very similar to the first regression in that four consecutive years of overcrowding was not statistically significant

and therefore I fail to reject the null hypothesis. Again, student teacher ratio is significant and has a negative relationship to ACT composite scores of eleventh graders.

Table 4

The Effects of Five Years of Consecutive Overcrowding on ACT Composite Scores for Eleventh Graders

VARIABLES	act_c_11
Five Years	-0.0269
	(0.800)
District Growth	-0.210
	(0.631)
Free & Reduced Lunch	9.78e-05
	(0.816)
Percent Asian	0.0279
	(0.483)
Percent Hispanic	0.213***
	(0)
Percent Black	-0.0334**
	(0.048)
Student Teacher Ratio	-0.0333***
	(0.0006)
Teacher Experience	0.0346*
	(0.075)
Constant	18.45***
	(0)
Observations	1,289
Number of Schools	192
R-squared	0.130

pval in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 4 shows the results from the third equation which measures five years of consecutive overcrowding and its effects on ACT Composite scores of eleventh graders. Similar to the other two equations, overcrowding, even for five consecutive years is not significant and therefore I fail to reject the null hypothesis. Student teacher ratio is again significant and negative, so as the ratio of students to teachers increases, ACT scores decrease.

Other notable results from the equations are that as the percentage of Hispanic students in a school increases, ACT composite scores for eleventh graders increases, but as the percentage of Black students in a school increases, ACT composite scores for eleventh graders decreases. Another interesting result of the three equations is that average years of teaching experience is positively correlated with ACT composite scores, meaning that the more years of experience a teacher has, the higher the students' ACT composite score will be.

### Limitations

The results of the two regression models are not definitive when determining the effects of overcrowding in Kentucky high schools on ACT scores of eleventh graders. There are some limitations to this study that should be noted. Of the 2,606 observations of 192 schools over thirteen years, only 27 percent were overcrowded for three consecutive years, 24 percent were overcrowded for four consecutive years and 21 percent were overcrowded for five consecutive years. In future studies, I would recommend using a sample with higher rates of overcrowding. By increasing the number of observations, there may be greater clarity of the effects of overcrowding on ACT scores.

Another limitation of this particular study is that ACT composite scores for eleventh graders only measures proficiency and are only available for the years 2008 through 2015. In today's education policy conversations, student academic growth has become a top priority. Inclusion of standardized test scores from previous years would help measure the effects of overcrowding on student academic growth, rather than proficiency (performance) as is measured in this model. Finally, another data related limitation of this model is that the data is aggregate school data, therefore it does not measure student level data. Because of the averaging of data

over school-wide variables, some of the effects of overcrowding may be lost in the aggregate. Student level data may provide a much more detailed picture of the effects of overcrowding.

### Conclusions and Recommendations

Though the effect of overcrowding for three years, four years and five years in Kentucky high schools isn't discernible from this model, there are lessons to be learned from this design that can be used in future research of overcrowding. It may be interesting to look at elementary and middle schools for the effects of overcrowding. Other fields of research focus heavily on early childhood education because students are very impressionable at this age. Overcrowding could have an effect on the foundational education that is provided at this young age. Also, in future studies, I would recommend using a growth measure versus a proficiency measure of student academic performance as was used in this model. In today's educational policy environment, policy makers and administration are increasingly interested in student academic growth rather than proficiency.

It may be the case that overcrowding may not have an effect on ACT composite scores of eleventh graders because the major symptom of overcrowding, increases in student teacher ratios, were maintained. As enrollment numbers rise, more teachers are sometimes hired and more classrooms created, thus maintaining low student teacher ratios. The presence of extra students in the building on its own, may not effect student academic performance.

Finally, it is important to recognize the impact that teachers have on student academic performance, notably, smaller student teacher ratios improve test scores. When student teacher ratios rise, meaning less one on one instruction as well as less attention and oversight, student

academic performance suffers. A measure of average years of teacher experience included in the model also contributes to this theory, as it is positively correlated to ACT scores.

Policy makers and school boards should monitor overcrowding in schools, specifically noting the number of students per teacher, as increased student teacher ratios can negatively impact student academic performance. Further testing using student academic growth measures and larger samples of overcrowded schools may lead to greater understanding of the effects of overcrowding of schools on student academic performance and can lead policy makers to make better informed decisions regarding expensive capital expenditures.

## References

- Graves, Jennifer. "The academic impact of multi-track year-round school calendars: A response to school overcrowding." *Journal of Urban Economics*. November 2009.
- Jones, John T., Ron W. Zimmer. "Examining the impact of capital on academic achievement." *Economies of Education Review*. June 2000.
- Kentucky Department of Education. *Kentucky School Report Cards*. 2008-2015.
- Kentucky Department of Education. *District Facility Plans*. March 2015.
- Lee, Valerie E. , Douglas D. Ready, Kevin Welner. "Educational Equity and School Structure: School Size, School Overcrowding, and Alternative Organizational Structures." UCLA IDEA. October 2002.
- Meehan, Mary. "Parents are organizing to press for second Scott County high school." *Herald Leader*. August 2016.
- National Center for Education Statistics, Common Core Data (CCD) *School Years 2002-2015*.
- National Center for Education Statistics. "Condition of America's Public School Facilities." *Statistical Analysis Report*. June 2000.
- National Center for Education Statistics. "Public School Principals Report on Their School Facilities: Fall 2005." *Statistical Analysis Report*. January 2007.
- Nye, Barbara, Larry V. Hedges, and Spyros Konstantopoulos. "The Long-Term Effects of Small Classes: A Five-Year Follow-up of the Tennessee Class Size Experiment." *Educational*

*Evaluation and Policy Analysis* 21, no. 2 (1999)

Rivera-Batiz, Francisco L. and Lillian Marti. "A School System at Risk: A Study of the Consequences of Overcrowding in New York City Public Schools." IUME Research Report. Columbia University. January 1995.

The Princeton Review. *About the ACT Test*. 2017.